INTRODUCTION CHAPTER 1

In 1996, Congress amended the Safe Drinking Water Act (SDWA) and substantially changed the approach for protecting the nation's drinking water supplies. These Amendments strengthened the U.S. Environmental Protection Agency's (EPA's) programs for reducing drinking water contamination by requiring the dissemination of more information to consumers, supporting better approaches for developing sound regulations, and enabling water systems to more easily implement needed improvements. This document was developed by EPA's Office of Ground Water and Drinking Water (OGWDW) for stakeholders and other interested parties to address one of the key areas affected by the 1996 Amendments: the use of benefit-cost analysis in establishing regulations for contaminants in drinking water.

EPA has used benefit-cost analysis for many years as one of several sources of information on the impacts of alternative policy choices. Traditionally, the cost side of the analysis includes estimating the expenditures needed to comply with new regulations (e.g., to install pollution control equipment) and determining the market effects of these expenditures (e.g., on the prices charged for the products of affected industries). The benefits side of the analysis generally focuses on the effects of reducing exposure to contaminants, including effects on human health and the environment.

EPA's ability to use the results of these analyses in decision-making under SDWA was limited prior to the 1996 Amendments. The Agency's choice of regulatory levels was constrained by statutory language requiring EPA to set Maximum Contaminant Levels (MCLs) as close to the MCLG as is "feasible" [SDWA, Section 1412(b)(4)(B)], and defined feasible as the use of the best technology and treatment techniques examined for efficacy under field conditions, taking cost into consideration [SDWA, Section 1412(b)(4)(D)]. Under the Amendments, EPA, at the discretion of the Administrator, may now establish less stringent MCLs if the costs of achieving the lowest feasible level are not justified by its benefits.

Because of the importance of these issues, EPA asked members of key stakeholder groups to assist in designing improved approaches to benefit-cost analysis. In 1998, EPA convened a Benefits Working Group to provide recommendations to the National Drinking Water Advisory Council on how EPA can best address the benefits of drinking water regulations. The Working Group's deliberations were carefully considered in the development of this document, and its report is included as Appendix A.

This document is divided into five chapters. The remainder of this first chapter introduces the benefits that may result from establishing MCLs for drinking water contaminants and describes the contents of the subsequent chapters in more detail. The second chapter describes the requirements for conducting benefit-cost analysis under SDWA as well as other applicable statutes and administrative orders. The third chapter describes the theory and methods for benefits analysis, focusing on the types of benefits most frequently associated with establishing drinking water MCLs. In the fourth chapter, we describe the benefit transfer technique, which is often used to estimate the value of benefits from environmental regulations. The fifth chapter provides information on how these analyses are implemented. An appendix summarizes the deliberations of the National Drinking Water Advisory Council's (NDWAC's) Benefits Working Group.

1.1 Types of Benefits

For environmental regulations, EPA generally defines benefits as the impacts of reducing the emissions of pollutants into the environment. In the case of regulations that establish MCLs (or, when necessary, treatment requirements) for public drinking water systems, these benefits result largely from reducing the adverse effects of contamination on users of this water, including households, commercial establishments, and industry.[1] The most significant effects of these regulations are improvements in human health, but other types of benefits (such as improved taste or reduced pipe corrosion) may also accrue.

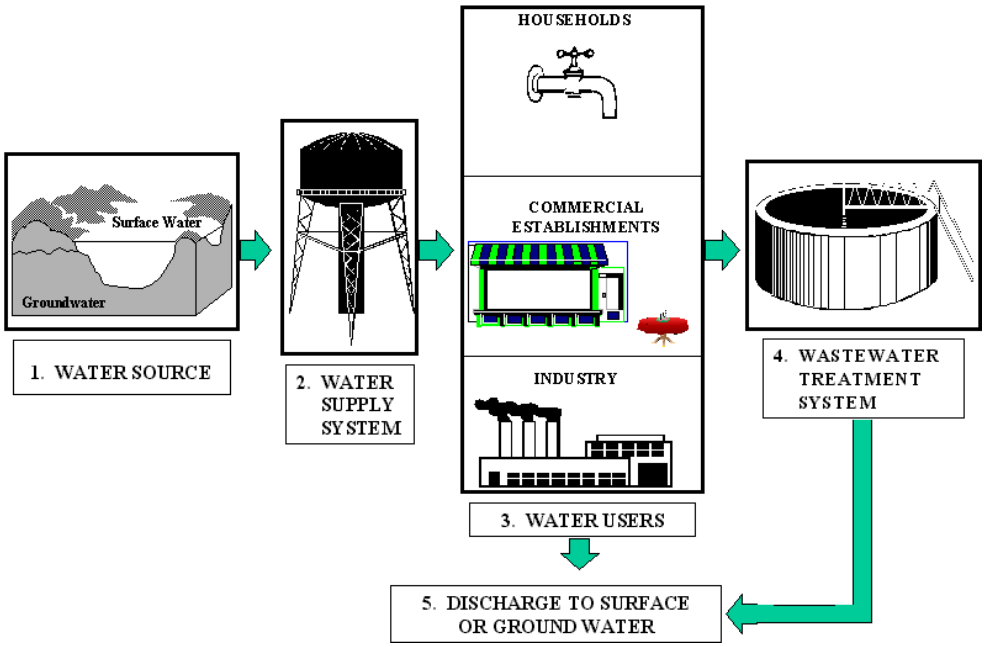
1.1.1 Water Supply Life-Cycle

In Exhibit 1-1, we provide a simple illustration of the life-cycle for publicly-supplied drinking water. This life-cycle begins with the surface or ground water sources that feed the water system. According to the U.S. Geological Survey, daily use of public water supplies totaled 40 billion gallons in the U.S. in 1995.[2] Surface waters are the source of about 62 percent of this supply; ground water sources account for the remaining 38 percent.

[1] "Public water systems" refer to systems serving the public (e.g., a community), which may be publicly or privately owned. Under the *National Primary Drinking Water Regulations* (40 CFR 141.2), these systems include those with at least 15 service connections or that regularly serve an average of at least twenty-five individuals at least 60 days per year.

[2] U.S. Geological Survey, *Estimated Use of Water in the United States in 1995,* 1997.

Exhibit 1-1
Public Water Supply Life-Cycle Overview



The water supply system collects water from these sources, treats it as necessary, and then distributes it to residential, commercial, industrial, or other users. EPA data indicate that about 47 percent of community water supplies were delivered to residential customers in 1995.[3] The remaining 53 percent includes commercial use (23 percent), industrial use (11 percent), government use (4 percent), agricultural use (1 percent), and wholesale (14 percent, primarily sales to other water systems for residential use). Once the water is used, it generally enters a sewer system and is conveyed to a wastewater treatment plant, where it is treated and discharged. Wastewater may also be directly discharged to surface water (e.g., by an industrial user) or released to ground water (e.g., when used for lawn-watering or treated by a home septic system).

Regulations establishing an MCL (or treatment requirements in lieu of an MCL) are likely to have the largest impact on the quality of water as it is delivered to the user

[3] U.S. Environmental Protection Agency, *Community Water Systems Survey, Volume 1: Overview,* January 1997.

(i.e., from Step Two to Step Three in Exhibit 1-1). The contaminants in discharges to surface and ground water (i.e., after Steps Three and Four) depend in part on the quality of the influent water supply and in part on how the water is used (e.g., for household hygiene or industrial cooling), and are generally regulated separately under the Clean Water Act and other authorities.

While MCLs focus on the quality of water delivered to end users, ground and surface water sources (Step One in Exhibit 1-1) can be affected by local decisions on how best to achieve an MCL. To comply with new regulations, systems may install treatment or blend contaminated and uncontaminated water to reduce concentration levels. Alternatively, systems may change the source of their water by connecting to a neighboring system, by developing a new well field, or by switching from ground water to surface water or vice-versa. Water systems may choose to implement source water protection measures rather than to undertake or improve water treatment.[4] They may take steps to for example, ban development in a buffer zone surrounding a water source. In the following chapters, we concentrate on the benefits associated with delivering cleaner water to users because, at a national level, these are likely to be the most significant benefits associated with new MCLs in most cases.

1.1.2 Major Benefit Categories

In this document, we organize "types of benefits" or "types of effects" into four major categories, based on the methods used to assess benefits (described in Chapter 3) within each category. This distinction is illustrated in Exhibit 1-2 and discussed below.

Exhibit 1-2
Benefits Terminology

Benefits categories represent the general types of benefits a regulation may produce. These include human health effects, ecological effects, aesthetic effects, and/or effects on materials.

Types of benefits are the specific types of effects within each category that are addressed by a regulation. For example, stomach cancer and kidney disease are two types of effects in the human health category that may be reduced by regulation of certain drinking water contaminants.

Methods for assessing benefits include both the approaches used to quantify physical effects (e.g., risk assessment) and the approaches used to determine the dollar value of the physical effects (e.g., survey research or market data).

[4] EPA also develops other types of regulations that protect water sources (e.g., by requiring industry to clean-up contaminated sites); this document focuses on regulations establishing MCLs.

Regulations establishing MCLs often have impacts that fall primarily into three categories: human health effects, aesthetic effects (e.g., taste, odor, color), and effects on materials (e.g., corrosion). The fourth category, ecological effects, may also be important in cases where the regulations increase source water protection or decrease the contamination associated with wastewater discharges or other wastes generated by water users or the system itself.

Households are often the users most significantly affected by regulations establishing MCLs both because of their level of water use and because of SDWA's focus on reducing risks to human health. Industrial or commercial establishments, who may use public supplies for drinking water or food preparation, as an input to a production process, or for cooling or cleaning, may also benefit from the establishment of MCLs. Government and agricultural use make up a relatively small proportion of the total use of publicly supplied water and often may be less substantially affected by related regulations than other types of use.

Determining the benefits categories affected by a particular regulation generally involves tracing the uses of the water supplies and the effects of changes in contamination levels on these uses. In some cases, the type of use affected may be passive; e.g., individuals may value simply knowing that clean water exists.

The relationship between use of public water supplies and potential benefits is illustrated by the examples in Exhibit 1-3 below. While the exhibit provides some examples of potential benefits for each type of user, it is not intended to be comprehensive; other types of benefits may accrue from regulation of individual contaminants. In general, analysts explore the types of benefits associated with a particular regulation on a case-by-case basis.

Exhibit 1-3

Public Water Users and Potential Benefits

User	Examples of Uses	Examples of Potential Types of Benefits From Improved Water Quality
Households	▸ Drinking water and food preparation	▸ Decreased health effects associated with ingestion; improved taste and odor
	▸ Showering and bathing	▸ Decreased health effects through dermal exposure and inhalation
Commercial establishments	▸ Drinking water and food preparation	▸ Decreased health effects associated with ingestion; improved taste and odor
	▸ Laundry and cleaning	▸ Reduced discoloration
Industry	▸ Drinking water and food preparation	▸ Decreased health effects associated with ingestion; improved taste and odor
	▸ Production input	▸ Improved product quality
	▸ Cooling and cleaning	▸ Reduced damage (e.g., corrosion, scaling) to equipment

Whether a specific use is affected by the regulations for an individual contaminant (or group of contaminants) will depend on both the characteristics of the contaminant and the changes in contamination levels attributable to the regulations. For example, in the case of a corrosive contaminant, damages to equipment or piping may be only partially reduced if the MCL is not set below the level at which noticeable damages occur. For a contaminant associated with lung disease, disease incidence may not be affected if the quantities inhaled (e.g., during showering) are not sufficient to cause the disease. The potential benefits therefore may vary substantially depending on the regulatory levels considered as well as the nature of the contaminants.

While for simplicity we have excluded the water system itself from Exhibit 1-3, benefits to the system may also accrue from regulations establishing MCLs, such as reduced damages to treatment equipment and distribution piping or changes in risks to the general public due to transportation of treatment residuals. Transportation or other risks are often best addressed as part of the risk assessment conducted for the benefits analysis (because such analysis requires the skills of health scientists), and direct savings to the system may be best addressed as part of the cost analysis (because such analysis requires the skills of water supply engineers and are an off-set to other compliance costs).

For example, if the use of new treatment techniques reduces pipe corrosion or blockage associated with the contaminant, cost analysts may choose to subtract the savings (from the reduced frequency of pipe repair or replacement) from the costs of installing and maintaining the equipment, rather than assessing the averted costs as part of the benefits analysis. To avoid double-counting, cost and benefit analysts agree in advance about whether each type of effect should be included in the cost or the benefit analysis.

As suggested by Exhibit 1-3 above, most of the benefits associated with regulations establishing MCLs fall into three categories: health effects, aesthetic effects (also referred to as amenities), and effects on materials (or materials damage). Exhibit 1-4 lists some examples of the types of effects that fall into each of these benefit categories. Methods for assessing these types of benefits are discussed in detail in Chapter 3 of this document.

Exhibit 1-4
Benefit Categories and Types of Benefits

Benefit Category	Examples of Types of Benefits
Human Health Effects	▸ Reduced mortality ▸ Decreased incidence of nonfatal cancers ▸ Decreased incidence of other nonfatal chronic and acute illnesses ▸ Reduced incidence of developmental, neurological, or reproductive effects
Aesthetic Effects	▸ Improved taste ▸ Improved odor ▸ Reduced discoloration
Effects on Materials	▸ Reduced corrosion or scaling ▸ Reduced build-up in piping ▸ Improved product quality

For regulations that lead to significant increases in source water protection, additional types of benefits may accrue. If source water protection is used in lieu of treatment to achieve an MCL, it will provide the same benefits (resulting from reducing contamination in water delivered to users of public supplies) as discussed above. In addition, source water protection may lead to ecological benefits stemming from the use of the water for recreational or commercial activities such as fishing, or from protection of biodiversity. "Nonuse" values, such as the pleasure of simply knowing that clean resources exist for current and future generations, may also be affected.

1.2 Use of this Report

The remainder of this document provides additional information on identifying and assessing these various types of benefits.

- Chapter Two, **Requirements for Benefits Analyses**, discusses the statutes, administrative orders, and other requirements that govern the conduct of benefits analysis at EPA. These requirements include those contained in SDWA as well as requirements developed by the Executive Office of the President and EPA to guide analyses of all major regulations. EPA analyses should also address several requirements for assessing impacts on business and government, as well as impacts on certain groups within the population, such as minorities, low income groups, and children.

- Chapter Three, **Methods for Benefits Analyses**, describes the theory and methods used in these analyses. It introduces several basic concepts and valuation methods, and then describes best practices for assessing effects on human health, aesthetics, and manufactured materials. Analysis of the ecological effects potentially associated with source water protection is also briefly described.

- Chapter Four, **Conducting Benefit Transfers**, provides information on how the benefit transfer technique is used to value the benefits of drinking water standards. Benefit transfer refers to the use of valuation information from one or more existing studies to assess similar, but not identical, effects.

- Chapter Five, **Implementing Benefits Analyses,** addresses the steps in the analysis and provides information on addressing data limitations and other issues. It also discusses several cross-cutting issues that arise when conducting these analyses, such as defining conditions with and without the regulations.

- Appendix A, **Report of the Benefits Working Group**, then provides the recommendations of the stakeholder group convened to advise EPA on these topics.

This appendix is followed by a list of references and an index to the major topics addressed in this document.

REQUIREMENTS FOR ECONOMIC ANALYSES CHAPTER 2

The process for developing Federal regulations has been subject to requirements for preparing supporting benefit-cost analyses for more than 20 years under an increasing variety of laws and executive orders.[5] In some cases these requirements focus on national analysis of regulatory impacts; in other cases they address effects on particular groups of concern, such as small businesses and government units, or minorities, low income groups, and children. For drinking water regulations, the Safe Drinking Water Act (SDWA) also contains several provisions that apply specifically to the analysis of benefits and costs.

This chapter summarizes the provisions of statutes, executive orders, and guidance documents that apply to the economic analysis of potential Federal regulations, with particular emphasis on the application of these requirements to the assessment of regulations establishing Maximum Contaminant Levels (MCLs) or treatment requirements for public drinking water systems. Many of these statutes, executive orders and guidance documents also contain requirements for the regulatory development process (e.g., for stakeholder involvement) and for the analysis of costs. While we allude to these other requirements, particularly where they constitute the primary purpose of an individual statute or executive order, we focus on information related to assessing benefits and comparing benefits to associated costs.

The purpose of this chapter is to introduce the requirements for the regulatory analyses described in these documents. The documents referenced in this chapter provide more detailed information on each set of requirements, as well as on the process for implementing and updating them.

2.1 The Safe Drinking Water Act

SDWA, as amended in 1996, provides the framework for developing National Primary Drinking Water Regulations, which establish MCLs or treatment techniques for controlling specific contaminants in drinking water.[6] SDWA also includes

[5] A concise summary of the development of the U.S. regulatory analysis program is contained in the U.S. Office of Management and Budget's *Report to Congress On the Costs and Benefits of Federal Regulations*, September 30, 1997. (The subsequent updates of this report do not provide this historical perspective.)

[6] The 1996 SDWA amendments and related information are available on EPA's Website at: http://www.epa.gov/ogwdw/sdwa/sdwa.html.

requirements for benefits assessment and for comparing benefits to costs as described below.

2.1.1 MCL Development Process

SDWA was originally enacted in 1974 and substantially amended in both 1986 and 1996. The 1986 Amendments specified 83 drinking water contaminants for regulation, and required EPA to regulate 25 of these contaminants every three years. EPA developed regulations for many of these contaminants before the 1996 Amendments, which changed the contaminant identification process to include risk-based prioritization of regulatory decisions with sound scientific peer review.[7]

In response to these new requirements, EPA must publish a list once every five years of unregulated contaminants it will consider for regulation [SDWA, Section 1412(b)(1)(B)]. Based on review of available information, the Agency must determine whether to regulate at least five contaminants from this list every five years. In accordance with these provisions, the Agency published its first *Contaminant Candidate List* of 60 chemical and microbial contaminants in March 1998, and will decide whether to proceed with developing regulations for at least five of these contaminants by August 2001.[8]

The 1996 Amendments maintain the Act's historic focus on the protection of public health. Specifically, SDWA Section 1412(b)(1)(A) directs the Administrator to focus on those contaminants that may have adverse human health effects, that are known or substantially likely to occur in public water systems at levels and with a frequency of concern to public health, and that present meaningful opportunities for health risk reductions if regulated. In all of these decisions, the Agency is further directed to draw data from the best available peer-reviewed science [SDWA, Section 1412(b)(3)(A)].

For each contaminant that EPA chooses to regulate, SDWA requires the Agency to publish a Maximum Contaminant Level Goal (MCLG) and issue a National Primary Drinking Water Regulation that would reduce health risks. In this regulation, EPA must either establish a Maximum Contaminant Level (MCL) and list technologies that can achieve compliance with the MCL (specifying compliance technologies for small systems), or (if it is not economically or technically feasible to monitor the

[7] In addition, the 1996 Amendments established specific requirements for the regulation of four contaminants: arsenic, radon, disinfection byproducts /cryptosporidium, and sulfate. The 1996 Amendments also require EPA to review and, if necessary, revise National Primary Drinking Water Regulations for currently regulated contaminants after six years.

[8] The Contaminant Candidate List and supporting information is available on EPA's Website at: http://www.epa.gov/ogwdw/ccl/cclfs.html.

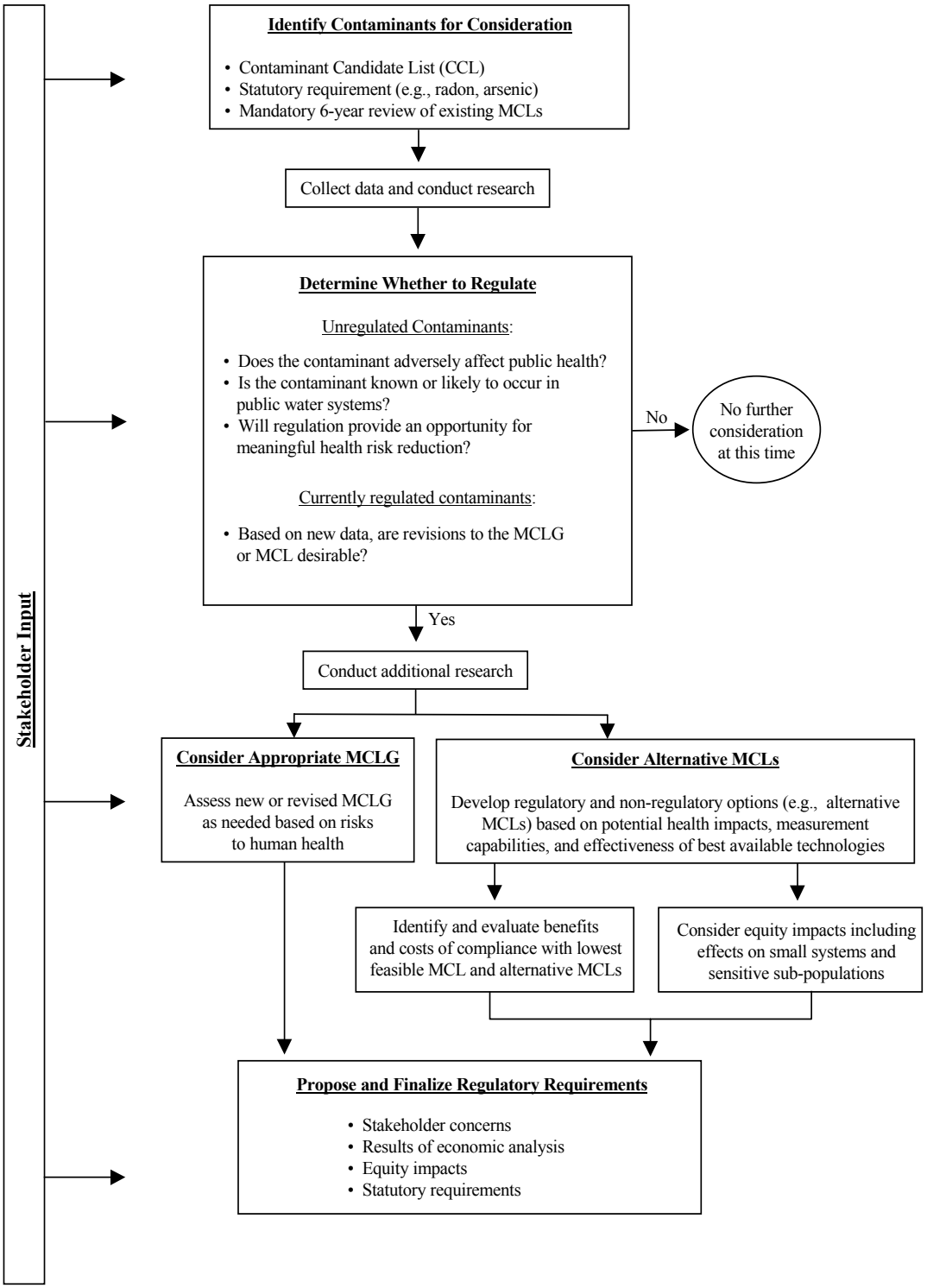
contaminant in drinking water) specify a treatment technology. EPA sets the MCLG at the concentration at which there are no known or anticipated adverse health effects associated with exposure to the contaminant, taking into account an adequate margin of safety and considering the effects on sensitive subpopulations. MCLGs for carcinogens are generally set at zero in the absence of data to support an alternative value. MCLGs for noncarcinogens are based on the Reference Dose (RfD, the level at which no adverse effects are likely to occur even for sensitive populations), combined with data on body weight, water consumption, and the percent of total exposure attributable to drinking water.

The 1986 SDWA amendments identified a process for setting MCLs as close to the MCLG as is "feasible" [SDWA, Section 1412(b)(4)(B)], and defined feasible as the use of the best technology and treatment techniques examined for efficacy under field conditions, taking cost into consideration [SDWA, Section 1412(b)(4)(D)]. This process was retained in the 1996 Amendments. However, under the 1996 Amendments, EPA can, at its discretion, establish a less stringent MCL that *"maximizes health risk reduction benefits at a cost that is justified by the benefits"* [SDWA, Section 1412(b)(6)(A)], with certain exceptions. In particular, SDWA Section 1412 (b)(6)(B) prohibits the Administrator from establishing a less stringent MCL if the benefits justify the costs for large water systems and those small systems not likely to gain variances, once the costs and benefits for those small systems likely to obtain variances are excluded from the analysis.

Exhibit 2-1 provides an overview of the regulatory development process under SDWA. EPA begins by selecting contaminants for regulatory consideration, then determines whether to proceed with developing new or revised regulations. These regulations may address both the MCLG and the MCL (or treatment requirements), depending on the status of the regulation and available research. The Agency considers the regulatory options and makes regulatory decisions based on stakeholder concerns, the results of the economic analysis, equity impacts, and statutory and other requirements.

Exhibit 2-1

OVERVIEW OF REGULATORY DEVELOPMENT PROCESS



2.1.2 Benefits Assessment

The 1996 SDWA Amendments impose significant new requirements on EPA for assessing benefits and for comparing benefits to costs. Specifically, when proposing any MCL, the Agency must publish an analysis of the benefits and costs of compliance with the MCL, including the following [SDWA, Section 1412(b)(3)(C)(i)]:

- the quantifiable and non-quantifiable health risk reduction benefits of control of the contaminant proposed for regulation at the specified MCL;
- the quantifiable and non-quantifiable health risk reduction benefits of any control of co-occurring contaminants that can be attributed solely to the proposed MCL, exclusive of compliance with other proposed or promulgated regulations;
- the quantifiable and non-quantifiable costs of compliance with the proposed MCL, including monitoring, treatment, and other costs, exclusive of costs of compliance with other proposed or promulgated regulations;
- the incremental costs and benefits associated with each alternative MCL under consideration;
- the effects of the contaminant on the general population, and on groups within the population that are likely to be at greater risk of adverse health effects from drinking water contaminants, such as infants, children, pregnant women, the elderly, and individuals with a history of serious illness;
- the increased health risks, if any, that may result from compliance with the proposed MCL, including risks associated with co-occurring contaminants; and,
- other relevant factors, including the quality of the available information supporting the analysis, the uncertainties in the analysis, and factors relating to the degree and nature of the identified risks.

If EPA proposes a treatment technique in lieu of establishing an MCL, the Agency must analyze the benefits and costs for the proposed treatment technique and alternatives considered, considering the same factors as listed above [SDWA, Section 1412(b)(3)(C)(ii)].

2.1.3 Comparison of Benefits to Costs

For each proposed MCL, SDWA further requires that the EPA Administrator publish a determination as to whether the benefits of the proposed regulation justify the costs [SDWA, Section 1412(b)(4)(C)], based on the analyses described above. If the benefits of setting the MCL at the feasible level would not justify the costs, *"the Administrator may, after notice and opportunity for public comment, promulgate an alternative MCL that will maximize health risk reduction benefits at a cost that would be justified by the benefits"* [SDWA, Section 1412(b)(6)(A)], with the exception (noted earlier) related to variances for small systems. These decisions are subject to judicial review [SDWA, Section 1448].

2.2 General OMB and EPA Guidance

In addition to the requirements imposed by SDWA, EPA benefit analyses must comply with more general provisions governing the assessment and promulgation of major Federal regulations. Executive Order 12866 establishes many of these requirements for major Federal regulations, defining major regulations as those that have an annual effect on the economy of $100 million or more, have other significant adverse economic impacts, are inconsistent with the actions of other agencies, alter the budgetary impact of Federal programs, or raise unusual legal or policy issues. The Office of Management and Budget (OMB) in the Executive Office of the President reviews major Federal regulations prior to promulgation under this Executive Order to ensure that they are consistent with the goals of the President and based on sound analysis and judgement.

OMB has developed guidance for preparing the benefit-cost analyses required under Executive Order 12866. This guidance focuses on ensuring that the analysis complies with "best practices" as defined by the economics profession. In addition, EPA has developed similar guidance tailored to its own regulations to ensure that the required analyses are performed consistently and accurately. This section first discusses the OMB guidance, "Guidelines to Standardize Measures of Costs and Benefits of Federal Regulations and Format of Accounting Statements" and then the EPA guidance, *Guidelines for Preparing Economic Analyses.*

2.2.1 OMB Guidance Under Executive Order 12866

Executive Order 12866, *Regulatory Planning and Review*, requires Federal agencies to conduct economic analyses of significant regulatory actions as a means to improve regulatory decision-making.[9] To assist agencies in carrying out these analyses, OMB issued guidelines to standardize benefit-cost analysis in their 2000 report to

[9] Executive Order 12866, *Regulatory Planning and Review,* September 30, 1993.

Congress.[10] As outlined in these guidelines, an economic analysis of a regulation should be designed to provide information for decision-makers on the potential benefits to society of alternative regulatory and nonregulatory approaches to risk management in comparison to potential costs, recognizing that not all benefits and costs can be described in monetary or even in quantitative terms. The guidelines focus on ensuring that decisions are based on the best available scientific, technical, and economic information.

The OMB guidelines are divided into four major sections:

- **General Considerations** discusses addressing the need for regulatory action, policy alternatives to consider, choice of a baseline, inclusion of non-monetized benefits and costs, and discounting of benefits and costs over time.

- **Benefit Estimates** describes the key concepts related to estimating benefits, valuing market and nonmarket goods, and valuing health and safety benefits.

- **Cost Estimates** provides an overview of the key concepts related to estimating costs, and the difference between real costs and transfer payments.

- **Other Key Considerations** describes methods for dealing with risk and uncertainty, use of sensitivity analysis to address alternative assumptions, distributional effects and equity considerations, and compliance assumptions.

In addition, the guidelines discuss a standard format for summarizing analytic results.

The guidelines are intended to provide a flexible framework for regulatory analyses, presenting information on practices that are consistent with the principles of economic theory. They also help standardize the measurement of benefits and costs of Federal regulatory actions. OMB emphasizes the need to clearly communicate the approach and findings of the analysis by presenting transparent analysis.

While the focus of OMB's regulatory review under Executive Order 12866 will vary depending on the characteristics of individual rules and the current priorities of the

[10] U.S. Office of Management and Budget, "Guidelines to Standardize Measures of Costs and Benefits and the Format of Accounting Statements," in *Appendix 4: Report to Congress on the Costs and Benefits of Federal Regulations,* March 22, 2000.

President, this guidance suggests that the criteria for acceptable analysis include consistency with the general principles of economics and clear justification of the analytic approach used for the particular rulemaking. The information on benefits analysis provided later in this document complies with these general principles.

2.2.2 EPA Guidelines for Economic Analyses

EPA first issued formal guidelines for the preparation of regulatory impact analyses in 1983 in response to President Reagan's Executive Order 12291(the predecessor to President Clinton's Executive Order 12866). EPA then amended these guidelines and added new appendices in 1991. Over the past four years, the Agency undertook a major effort to update and revise these guidelines, finalizing its *Guidelines for Preparing Economic Analyses* in 2000.[11]

EPA's guidelines generally follow the same framework as OMB's guidance. The EPA *Guidelines* are in part based on research commissioned by EPA's Economic Consistency Work Group and subsequent decisions made by its Regulatory Policy Council. This research focused on six areas that are central to the preparation of sound regulatory analyses: defining the baseline, selecting discount rates, valuing mortality risk reductions, addressing equity and distributional issues, evaluating uncertainty, and assessing non-quantified and non-monetized effects. The EPA *Guidelines* incorporate new advances in applied economic research, and address the analytic requirements of a number of recent statutes and executive orders.

The EPA *Guidelines* are substantially more detailed than the OMB guidelines mentioned above, but place a similar emphasis on applying best practices derived from the field of economics, using informed professional judgement to appropriately design and implement the analysis, and ensuring that the analytic methods and results are clearly communicated. The EPA *Guidelines* address the following topics:

- Statutory and executive order requirements for conducting economic analyses;
- Stating the need for the proposal, including guidance on procedures and analyses for clearly identifying the environmental problem to be addressed and for justifying Federal intervention;
- Developing regulatory and nonregulatory approaches for consideration;

[11] U.S. Environmental Protection Agency, *Guidelines for Preparing Economic Analyses*, EPA 240-R-00-003, September 2000.

- Understanding the theoretical foundations of economic analyses, as well as general guidance on specifying the baseline, predicting responses to the regulations, and assessing uncertainty;
- Approaches to social discounting;
- Assessing the benefits of environmental policies;
- Analyzing the social costs of environmental policies;
- Assessing the economic impacts and equity effects of environmental policies; and,
- Using economic analyses in evaluating policy options.

The EPA *Guidelines* include a thorough discussion of the benefits categories, general analytic approach, and methods applicable to the assessment of benefits of environmental regulations. A review of these topics, illustrated with examples of their application to drinking water regulations, is included in Chapters 3 and 4 of this document. Several other topics addressed by the EPA guidelines affect both the cost and benefit analysis (e.g., the definition of the baseline) and are briefly summarized in Chapter 5 of this document.

2.3 Requirements Related to Impacts on Government and Business Units

The increasing scope and number of environmental and other regulations have raised concerns in recent years over the economic impacts of Federal actions on state and local governments and the business community. EPA is subject to two primary sets of requirements for assessing these types of impacts.[12] The Unfunded Mandates Reform Act requires EPA to assess the impacts of Federal regulations on non-Federal government units and to minimize associated costs (when not offset by adequate Federal funding). The Small Business Regulatory Enforcement Fairness Act amends the Regulatory Flexibility Act; in combination these Acts establish analytical and procedural requirements for addressing the impacts of Federal regulations on small government and business entities. As discussed below, the guidelines for addressing these statutory requirements focus largely on the analysis

[12] In addition to these statutes, EPA is subject to Executive Order 13132, *Federalism,* which requires intergovernmental consultation. Executive Order 13084, *Consultation and Coordination with Indian Tribal Governments,* also requires consultation on potential regulatory requirements. However, these Orders do not specifically address the conduct of economic analysis.

of costs, but information on associated benefits is often useful for related decision-making.

2.3.1 The Unfunded Mandates Reform Act (UMRA)

The Unfunded Mandates Reform Act (UMRA), which Congress enacted in 1995, requires that Federal agencies assess the budgetary impacts of proposed regulations on state, local and tribal governments as well as on the private sector. The general requirements for analysis under UMRA are very similar to the requirements described in the above-mentioned OMB and EPA guidance for regulatory analysis, but focus on the effects of Federal requirements on other government entities and the private sector. Information on complying with the requirements of UMRA can be found in OMB's *Guidance for Implementing Title II of S.1*.[13] EPA is also developing draft guidance on these topics.

Title II of UMRA directs agencies to prepare an economic analysis prior to promulgating any regulation that may mandate direct expenditures of $100 million in any one year by state, local, and tribal governments combined, or by the private sector. The statute further requires that the economic analysis include:

- a qualitative and quantitative assessment of the anticipated benefits and costs of the mandate, including its effects on health, safety, and the natural environment [Section 202(a)(2)];

- an assessment of the extent to which Federal resources and financial assistance (e.g., through the Drinking Water State Revolving Fund) are available to offset the costs imposed on state, local, and tribal governments [Section 202(a)(2)(A)];

- estimates, where feasible, of disproportionate budgetary effects on any particular region, any particular state, local, or tribal government, any particular type of community (e.g., urban or rural), or particular segments of the private sector [Section 202(a)(3)(B)]; and,

- estimates, where feasible, of the proposed regulation's effects on the national economy (e.g., its effects on productivity, economic growth, employment, and job creation) [Section 202(a)(4)].

[13] U.S. Office of Management and Budget, *Guidance for Implementing Title II of S.1,* Memorandum from Sally Katzen, March 31, 1995. Information on the historical relationship between UMRA and SDWA is also provided in: U.S. Congressional Budget Office, *The Safe Drinking Water Act: A Case Study of an Unfunded Federal Mandate,* September 1995.

To foster greater communication and coordination between all levels of government during regulatory development, UMRA also includes requirements for Federal consultation with representatives of state, local, and tribal governments so as to provide "meaningful and timely" input to the development of a regulatory proposal [UMRA, Section 204].

For each proposed rule, UMRA requires that agencies *"consider a reasonable number of regulatory alternatives and ... select the least costly, most cost-effective, or least burdensome alternative,"* unless this provision is inconsistent with applicable law. Otherwise, the Agency must publish (with the final rule) an explanation of why the least costly, most cost-effective, or least burdensome alternative was not chosen. In total, the requirements of UMRA suggest that analysts may wish to disaggregate both benefit and cost estimates so that the cost impacts of any significant unfunded mandates can be compared to their benefits for the particular types of affected entities. In addition, the requirements of UMRA must be taken into account when selecting the regulatory options to be considered in the benefit-cost analysis.

2.3.2 The Small Business Regulatory Enforcement Fairness Act (SBREFA)/Regulatory Flexibility Act (RFA)

The Small Business Regulatory Enforcement Fairness Act (SBREFA) was passed in 1996, amending the Regulatory Flexibility Act (RFA) of 1980. The purpose of these combined statutes is to ensure that agencies consider the economic impacts of their regulations on small entities, both public and private, and provide flexibility to minimize these impacts. Many of the specific requirements in these statutes apply primarily to the analysis of the direct economic impacts (i.e., costs) associated with regulatory compliance and related decision-making; however, analysts may also wish to provide information on benefits to help inform these decisions. These statutes also contain specific requirements for consulting with representatives of small entities and for publishing a small entity compliance guide. EPA guidance for implementing SBREFA and RFA is available in: *Revised Interim Guidance for EPA Rulewriters: Regulatory Flexibility Act as Amended by the Small Business Regulatory Enforcement Fairness Act* and related documents.[14]

[14] U.S. Environmental Protection Agency, *Revised Interim Guidance for EPA Rulewriters: Regulatory Flexibility Act as Amended by the Small Business Regulatory Enforcement Fairness Act,* March 1999; and U.S. Environmental Protection Agency, *1999 Update to Elements of a Reg Flex Analysis,* 1999. The U.S. Small Business Administration (SBA) has also developed guidance (*Implementation Guide for the RFA,* February 1998). However, the SBA differs from EPA in its legal and policy interpretations of some provisions of SBREFA and RFA.

The RFA provides definitions of small entities, including "small businesses," "small governments," and "small organizations." However, for drinking water regulations, EPA's policy has been to instead define water systems serving less than 10,000 customers as small entities.[15] Such systems account for nearly 95 percent of all community water systems nationwide, although they serve relatively small populations and hence provide a much smaller proportion of total water supplies. EPA's definition of small water systems does not correspond precisely to the definition of small entity under RFA; however, EPA has in the past consulted with and received approval from the Small Business Administration for the use of this alternative definition.[16]

Under SBREFA and RFA, EPA must evaluate the reporting, record-keeping, and other compliance requirements imposed on small entities by the proposed regulation. EPA must also consider regulatory alternatives and other measures that can minimize the economic impact of the proposed regulation on small entities while accomplishing the stated objectives of the applicable statute(s). Because the Acts' requirements are potentially resource intensive, analysts first conduct a screening analysis to determine if a full "Regulatory Flexibility Analysis" is required. A detailed analysis is not required if the agency can certify that the rule *"will not, if promulgated, have a significant economic impact on a substantial number of small entities."* It is EPA's policy, however, to consider a rule's impact on any small entities and minimize any adverse impact to the extent feasible, regardless of whether a full Regulatory Flexibility Analysis is required.

The specific requirements for these analyses focus on the adverse economic impacts of the regulations, and generally do not specifically address benefits. However, disaggregate information on the benefits to small entities may be useful in decision-making, particularly if the benefits analysis addresses cost savings (e.g., from reduced pipe corrosion) that may offset compliance costs. Decision-makers may also be interested in information on the extent to which small systems account for a disproportionately large or small share of the total benefits of the regulations. Actions taken to minimize economic impacts on small entities could include the granting of waivers or the adoption of alternative standards, which will affect overall costs and benefits under the regulations. As noted earlier (in Section 2.1 of this chapter), the SDWA requirements for considering whether benefits justify costs explicitly take into consideration the availability of variances for small systems.

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[15] U.S. Environmental Protection Agency, *National Water Quality Inventory: 1994 Report to Congress,* 1994.

[16] See, for example, U.S. Environmental Protection Agency. "National Primary Drinking Water Regulations: Consumer Confidence; Proposed Rule," *Federal Register,* Vol. 63, No. 30, p. 7605, February 13, 1998.

2.4 Requirements Related to Impacts on Subpopulations

In addition to the SDWA requirements for addressing risks to sensitive subgroups when developing MCLs (see Section 2.1 above), recent executive orders require the consideration of effects on minority and low income groups and children.[17] As mentioned in Section 2.2, both the OMB and EPA guidance also require addressing any potentially disproportionate adverse impacts on a number of groups. Below, we describe the two executive orders and related guidance that explicitly address the risks imposed on specific subpopulations: Executive Order 12898 on environmental justice, and Executive Order 13045 on children's health.

2.4.1 Environmental Justice

Under Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, each Federal agency is required to identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." Specifically, the Order requires each agency to develop an environmental justice strategy. This strategy must include provisions for improving related research and data collection efforts, for ensuring greater public participation, and for identifying differential patterns of natural resource consumption among minority and low-income populations.

Accordingly, EPA's 1995 *Environmental Justice Strategy: Executive Order 12898* develops objectives for partnerships, data collection, and outreach in five mission areas central to the promotion of environmental justice:

- public participation, accountability, partnerships, outreach, and communication with stakeholders;
- research on health and environmental issues (e.g., ongoing cooperative studies of drinking water consumption patterns and resulting contaminant exposures by EPA and USDA);
- data collection, analysis, and stakeholder access to public information;
- environmental protection for American Indian, Alaska native and indigenous peoples; and

[17] In addition, as noted earlier Executive Order 13084 requires consultation with tribal groups.

- enforcement, compliance assurance, and regulatory review.[18]

EPA's *Environmental Justice Handbook*, issued in September 1993, defines environmental justice as the fair treatment of people of all races, incomes, and cultures with respect to the development, implementation, and enforcement of environmental laws, regulations and policies. To help ensure that fair treatment, the Agency has developed an *Environmental Justice Implementation Plan* designed to foster progress toward achieving the objectives specified in the *Environmental Justice Strategy*. Additional guidance for addressing environmental justice concerns in the context of the National Environmental Policy Act (NEPA) is provided by EPA and the Council on Environmental Quality.[19]

In addition, EPA's Office of Ground Water and Drinking Water and Office of Science and Technology are undertaking several efforts to address these issues. EPA published the *Safe Drinking Water Act Guide for Environmental Justice Stakeholders* and convened a meeting of these stakeholders in March 1998.[20] EPA's health scientists are also researching several issues concerning the sensitivity of various groups to drinking water contaminants. The implications of these issues for benefits analyses are two-fold. First, the analysis of health risks should consider the extent to which minority groups or low income populations may be more sensitive to the effects of contaminants than the general population, either due to baseline health conditions or patterns of exposure to drinking water contaminants. Second, any disproportionate adverse affects of contaminants on these populations should be addressed and highlighted in benefits analyses.

2.4.2 Children's Health

Recognizing the growing body of evidence that children may be more susceptible or vulnerable to adverse health effects resulting from environmental contaminants, the EPA Administrator in the fall of 1995 issued a *Policy on Evaluating Health Risks to Children*. This policy directed the Agency, when setting standards to protect public health, to explicitly and consistently consider risks to children and infants. The

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[18] U.S. Environmental Protection Agency, *Environmental Justice Strategy: Executive Order 12898*, April 1995. More information on environmental justice issues, including information on the other documents cited in this section, can be found on EPA's Environmental Justice Website: http://www.epa.gov/oeca/oej.

[19] U.S. Environmental Protection Agency, *Interim Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses,* Office of Federal Activities, April 1998, and Council on Environmental Quality, *Guidance for Addressing Environmental Justice Under the National Environmental Policy Act*, March 1998.

[20] Information on these efforts is available on EPA's Website at http://www.epa.gov/ogwdw/ndwac/sum_ej-a.html.

Policy was subsequently reinforced by the announcement of EPA's *National Agenda to Protect Children's Health from Environmental Threats.* The Agenda stipulated that, as a matter of policy, all standards EPA sets will be protective enough to address the potentially heightened risks faced by children.

In April 1997, President Clinton issued Executive Order 13045, *Protection of Children From Environmental Health Risks and Safety Risks*, directing all Federal agencies to give high priority to the identification and assessment of disproportionate environmental health risks and safety risks to children, to coordinate research on children's health, and to ensure that their standards address disproportionate risks to children.[21] The Order further directs agencies, when proposing and promulgating regulations concerning environmental health risks or safety risks that may disproportionately affect children, to submit to OMB an evaluation of the proposed regulation's environmental health or safety effects on children, and an explanation of why the proposed regulation is preferable to other reasonably feasible alternatives considered by the agency.

In May 1997, the Administrator created the Office of Children's Health Protection (OCHP) to coordinate the implementation of Executive Order 13045 and the Agency's *National Agenda*. To assist Agency staff in the regulatory development and assessment process, OCHP and the Office of Regulatory Management and Information issued draft Interim Final Guidance on implementation of the executive order in *EPA's Rule Writer's Guide to Executive Order 13045: Guidance for Considering Risks to Children During the Establishment of Public Health-Related and Risk-Related Standards*.[22] This guidance is designed to ensure that the "analytical blueprint" for the regulatory development process includes the components required by the Executive Order; it also addresses issues related to distinguishing between risk assessment and risk characterization.

This general concern about children's health effects is also reflected in SDWA. As discussed earlier in Section 2.1, SDWA requires EPA to evaluate health risk reduction benefits for those groups within the population that are likely to be at greater risk of adverse health effects from drinking water contaminants, including infants and children. Benefits analysts therefore pay particular attention to children's health risks when assessing the effects of drinking water regulations, highlighting potentially significant impacts.

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[21] These documents and other information related to children's health effects are available on EPA's Website at: http://www.epa.gov/children.

[22] U.S. Environmental Protection Agency. *EPA's Rule Writer's Guide to Executive Order 13045: Guidance for Considering Risks to Children During the Establishment of Public Health-Related and Risk-Related Standards*, Review Draft, April 21, 1998.

2.5 An Integrated Approach

As the above discussion makes clear, the development of drinking water regulations is subject to the provisions of several statutes, executive orders, and guidance documents. One of the primary challenges for regulatory analysts and decision-makers in assessing the benefits of regulatory options is to integrate these many requirements into a coherent analytic strategy. This strategy generally includes a national benefit-cost assessment, and, as appropriate, evaluation of the effects on distinct subgroups of the affected population (e.g., small businesses, government entities, children, minorities, or low-income households).

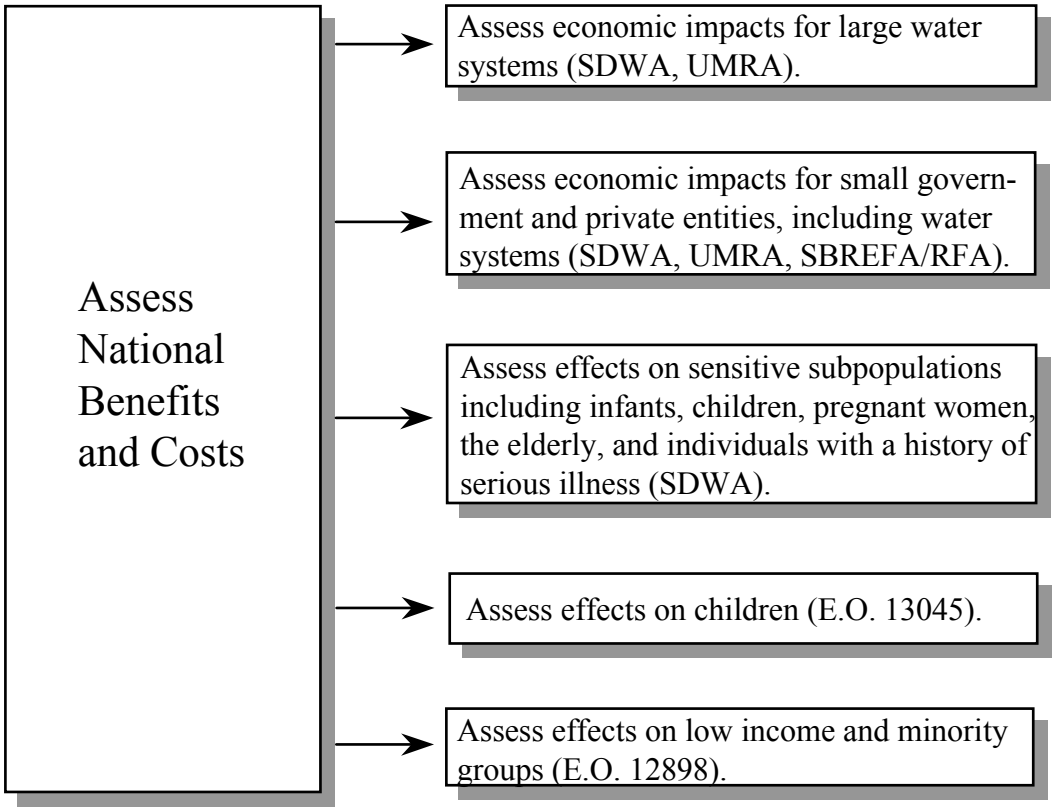
Some of the statutes and executive orders discussed earlier are applicable to all actions taken by the Agency, whereas others are applicable only to "major" regulations. Exhibit 2-2 summarizes the applicability of each set of requirements. In parentheses, we indicate the section of this chapter that provides more information on each set of requirements and that references sources of additional information on applying these criteria.

Exhibit 2-2
Applicability of Statutory and Executive Order Requirements for Benefit-Cost Analysis

Safe Drinking Water Act (see Section 2.1 above): All National Primary Drinking Water Regulations.
Executive Order 12866, "Regulatory Planning and Review" (see Section 2.2.1 above): All "significant regulatory actions" that may "(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities; (2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; (3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or (4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order."
Unfunded Mandates Reform Act (see Section 2.3.1 above)**:** All rules that "may result in the expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of $100,000,000 or more (adjusted annually for inflation) in any 1 year."
EPA Guidelines for Preparing Economic Analyses (see Section 2.2.2 above): Not specified; generally applies to all economic analyses prepared by EPA.
Small Business Regulatory Enforcement Fairness Act and the Regulatory Flexibility Act (see Section 2.3.2 above): All rules that will have "a significant economic impact on a substantial number of small entities."
Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations" (see Section 2.4.1 above): No specific criteria; generally applies to all EPA programs.
Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks" (see Section 2.4.2 above): All "economically significant" rules as defined under Executive Order 12866 that "concern an environmental health risk or safety risk that an agency has reason to believe may disproportionately affect children."

Exhibit 2-3 summarizes the necessary disaggregated analyses and indicates the source of the requirement (e.g., SDWA), as discussed in previous sections of this chapter.

Exhibit 2-3
Summary of Required Analyses



To meet the requirements specified in Exhibit 2-3, benefits analysts work with others, such as cost analysts, health scientists, and stakeholders, in developing the overall economic analysis. Proper assessment of disproportionate health risks to sensitive populations, for example, involves consultation with health researchers and risk assessors to integrate the latest information on health risks to children and other groups. Similarly, effective and meaningful comparison of benefits and costs for small entities involves working closely with cost analysts and representatives of small water systems to address related impacts.